Wildlife Research 2018, **45**, 208–219
doi:10.1071/WR16103_AC

Supplementary material

Invasive predators represent the greatest extinction threat to the endangered northern bettong (*Bettongia tropica*)

Tegan Whitehead[A,C], *Karl Vernes*[B], *Miriam Goosem*[A] *and Sandra E. Abell*[A]

[A]Centre for Tropical Environmental and Sustainability Science and College of Marine and Environmental Sciences, James Cook University, Cairns, Qld 4878, Australia.

[B]Ecosystem Management, University of New England, Armidale, NSW 2351, Australia.

[C]Corresponding author. Email: tegan.whitehead@my.jcu.edu.au

Table S1. Base model of life-history parameters and age class mortalities used in population viability analyses of *Bettongia tropica* on the Lamb Range, northeastern Queensland.

Scenario settings	**Data input**	**Justification**
Duration of simulations (yrs)	100	
Number of iterations	1000	
Number of populations	4	Vernes and Pope (2006) showed that Davies, Tinaroo, Emu and Bridle Creeks all had viable populations. All four were modeled as a metapopulation.
Dispersal		
Dispersing Class	males aged 1 yr	
% Surviving Dispersers	87%, but no dispersal into saturated populations	See below for discussion of survivorship
Percent dispersing/immigrating	20%	Pope *et al.* (2012) showed 80% of males are sedentary, whilst 20% disperse. Bridle Creek and Tinaroo Creek are the most northerly and southerly populations, with 20% of individuals modelled to disperse to adjacent populations at Davies Creek and Emu Creek respectively. Davies Creek and Emu Creek provide 10% dispersal to populations located to north and south.
Life-history parameters		
Inbreeding	No	

Mating system	Short-term monogamy or polygyny	Pope *et al.* (2012) defined *B. tropica* mating system as 'overlap promiscuity,' however it may be 'serial monogamy'.
Female breeding age (years)	1	Vernes and Pope (2002) estimated earliest age of reproduction for females was at 9-12 months; Johnson and Delean (2001) suggested captive *B. tropica* females can breed at 1 year.
Male breeding age (years)	1	Males estimated to reach sexual maturity at same age as females (1 year) (Vernes and Pope 2002).
Maximum breeding age (years)	5	Vernes and Pope (2002) recorded individuals alive at 4.9 years of age, so it is estimated that animals can breed to 5 years.
Maximum age (including non-breeding senescence)	7	Seebeck and Rose (1989) suggested that potoroids live up to (perhaps beyond) 7 years in the wild. However, older animals (≥ 8 yrs) in a captive colony of *Aepyprymnus rufescens* at University of New England (unpublished) could not produce young.
Sex ratio at birth (% males)	50	Vernes and Pope (2002) found no significant difference in sex ratio at birth.
Number of broods per year	3	Johnson and Delean (2001) recorded continuous breeding in a captive population, as is typical of other potoroids (Seebeck and Rose 1989). Vernes and Pope (2002) recorded *B. tropica* pouch life of 106 days, with young born in all months. A female can thus theoretically rear three successive pouch young to permanent pouch emergence each year.
Number of progeny per brood	1	Single young have only ever been recorded (Vernes and Pope 2002), although twins may occur in extremely low rates (as found in other macropod species).
Percent adult females breeding each year	96	Vernes and Pope (2002) found that of 120 captures of adult females, 115 (96%) were carrying a pouch young at the time of capture.

Standard deviation (SD) in percent of females breeding	3.9	Using VORTEX 10 and data from Vernes and Pope (2002), a SD of 3.9 was estimated (8%/2.06 SD units (over 4 years)
Of females breeding, percentage producing 1, 2, or 3 offspring?	1 offspring = 8 2 offspring = 34 3 offspring = 58	The likelihood of a female having 1, 2 or 3 young/year was calculated from Table 2 in Vernes and Pope (2002). 8% of females were estimated to have had 1 young (and lost the others), 34% had two young (but lost the third) and 58% carried all 3 young to permanent pouch emergence.
Age class mortalities (percent for males and females including environmental variation/standard deviation)		
0-1 year	48 (SD = 10)	Vernes and Pope (2002) recaptured 6 of 29 pouch young as sub-adults, indicating 79% of pouch young did not survive. About 50% did not survive until permanent emergence from the pouch. Therefore, assumed mortality was 40%. Of sub-adults tagged (21 animals: 9 females, 12 males) only 6 females (6/9 = 67%) and 3 males (3/12 = 25%) were recaptured as adults. Pope *et al.* (2012) estimated that male:female dispersal is 80:20 biased towards males. Mortality of sub-adults was therefore estimated at 13% (67+20 = 87% survival). 40% mortality from pouch to sub-adult, and 13% from sub-adult to adult yields average mortality of approx. 48%.
1+ years	15 (SD = 2)	Adult survivorship probability has been estimated at ≥80% (Vernes and Pope 2002). Adult mortality was therefore estimated as 15% (85% survivorship), with low (2%) standard deviation.
All adult males breeding	Yes	
Start at stable age distribution	Yes	

Initial population size (N)	BC = 105 DC = 225 EC = 300 TD = 435	Each population was treated as a 30 km^2 cell (5 km long x 6 km wide - the width of the dry end of wet sclerophyll occupied by *B. tropica* on the Lamb Range). Applying maximum densities calculated by Vernes and Pope (2006), initial population sizes for each location are: Bridle Creek (BC): 30 km^2 x 3.5 bettongs/km^2 = 105 animals; Davies Creek (DC): 30 km^2 x 7.5 ± 1.20 bettongs/km^2 = 225 ± 26 animals; Emu Creek (EC): 30 km^2 x 10 bettongs/km^2 = 300 animals; Tinaroo Creek (TC): 30 km^2 x 14.5 bettongs/km^2 = 435 animals. Population densities were calculated by undertaking Jolly-Seber analysis of *B. tropica* captures at each site, with 10 three-night trapping sessions conducted between November 1994 and December 1996. Sampling effort varied between sites, with 125 trap nights conducted at Bridle Creek, 4,267 at Davies Creek, 130 at Emu Creek and 334 at Tinaroo Dam. It is thus acknowledged that differences in sampling effort may have influenced population abundance estimates.
Carrying capacity (K)	As above	Observations 17 years ago suggest the carrying capacity was equal to the initial population size. Although the current carrying capacity might be lower, this is the best estimate available.
Standard deviations in carrying capacity	10%	A 10% deviation allows for population fluctuation.
Trend in carrying capacity	No	
Harvest of individuals	No	
Supplementation	No	
Specify exact distribution	Yes	